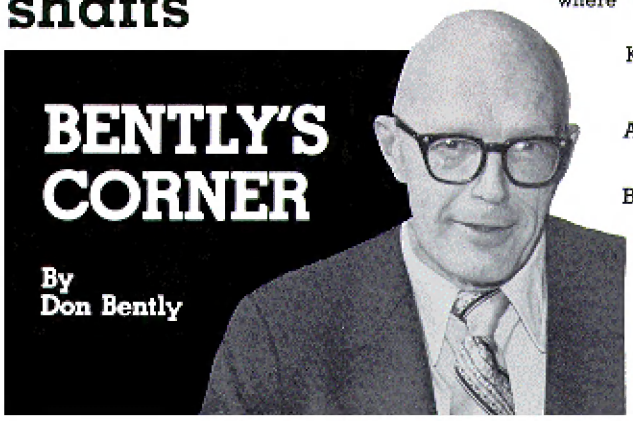
A formula for verifying cracked shafts



$$\tan (A + B) = \frac{(K_{normal})}{(K_{weak})} \tan B$$

where K_{normal} = normal spring rate of the shaft

K_{weak} = spring rate of shaft deflected at the crack

A = deflection of the shaft with respect to the imbalance

B = angle of the imbalance with respect to the crack as shown in Figure 1:

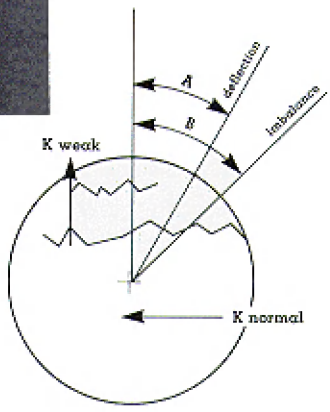


FIGURE 1

In the Spring/Summer 1981 **ORBIT**, we identified a breakthrough in detecting cracked shafts. We found that a shaft which has asymmetric stiffness due to a lateral crack is cross coupled.

We showed how the behavior of a shaft with a lateral crack may be observed by loading the shaft with a weight and noting the vertical and horizontal deflection as the shaft is rotated.

This same test may be performed on a machine by installing a trial weight of a fixed amount at a fixed radius at one place every 30 to 45 degrees successively around the rotor and by testing the response of the rotor system for each angular location of the trial weights.

The effect of a lateral crack in a shaft of the High Spot, leading or lagging the Heavy Spot at static or low speed was noted. The simple equation for this effect is:

Figure 2 shows this equation graphed for typical values of cracked shaft stiffness ratios. This angle is leading or lagging, depending on the direction of rotation and, of course, continues for the next 90 degrees, unless the crack closes (a "breathing" crack). If the crack closes, the stiffness ratio is unity half of each turn, and there is no cross couple action for that 90 degree sector. The ratio of the shaft stiffness is determined experimentally by observing the minimum and maximum amplitude readings for the resultant deflection for any imbalance weight.

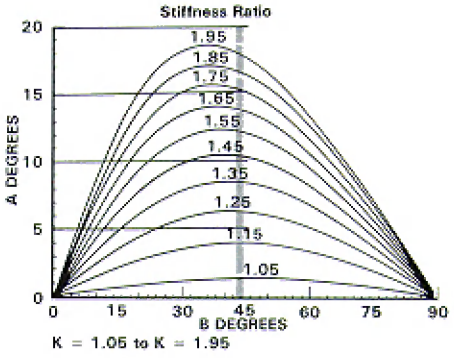
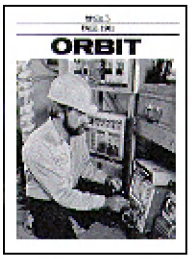


FIGURE 2

Donald E. Bently, President of Bently Nevada, will be a featured lecturer at the Rotor Dynamics Engineering and Applied Vibration Engineering concurrent seminars in Daytona Beach, Florida, February 15-18, 1982. Sponsored by Union College, Schenectady, New York.

For further information, contact Mrs. Rae D'Amelio, Continuing Education Department, Wells House, 1 Union Avenue, Schenectady, New York 12308, (518) 370-6288.

CONTENTS



ORBIT

ORBIT is published quarterly by the Product Promotions Department, Bently Nevada Corporation, to keep its customers informed on developments in the field of machine monitoring and diagnostic equipment. Questions and suggestions may be addressed to **ORBIT**, P.O. Box 157, Minden, NV 89423, or contact your local sales representative.

Editor	Coco Crum
Designer	Benny Goodman
Photographer	Alan Wilde
Printing	Dennis Evans
Artist	Norm Scott
Artist	Debbie Decker
Writer	Nick Lauri
Typesetter	Geir Martinsen
Media Assistant	Jan Cessna

Contributors this issue: Ben Wofford, Richard Dunn, Steve Riggs, Mark Gilstrap, Bill Arnold.